

Atty Docket: 2003-IP-011752U1  
(1391-39401)

Patent

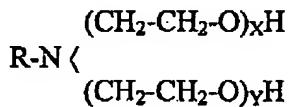
LISTING OF CLAIMS

1. (Original) A method of fracturing a subterranean formation, comprising the steps of:
  - (a) providing a fracturing fluid having a first pH;
  - (b) foaming the fracturing fluid;
  - (c) introducing the foamed fracturing fluid into a subterranean formation to fracture the subterranean formation; and
  - (d) defoaming the fracturing fluid by changing the pH of the fracturing fluid to a second pH *in situ* in the subterranean formation.
2. (Original) The method of claim 1 wherein the change in pH is achieved via contact with an acidic material.
3. (Original) The method of claim 2 wherein the acidic material is naturally occurring.
4. (Original) The method of claim 3 wherein the acidic material is clay.
5. (Original) The method of claim 3 wherein the acidic material is acidic water.
6. (Original) The method of claim 1 wherein the first pH and the second pH are each basic, the second pH being less basic than the first pH.
7. (Original) The method of claim 1 wherein the fracturing fluid is foamed with nitrogen.
8. (Original) The method of claim 1 wherein the fracturing fluid deposits a proppant in fractures formed in the subterranean formation when the foam is reduced.
9. (Original) The method of claim 1 wherein the fracturing fluid comprises a surfactant that facilitates formation of the foam at the first pH and that facilitates reduction of the foam at the second pH.

*Atty Docket: 2003-IP-011752U1  
(1391-39401)*

*Patent*

10. (Original) The method of claim 9 wherein the surfactant is a tertiary alkyl amine ethoxylate generally represented by the following formula when the pH of the fracturing fluid is the first pH:



wherein R is an alkyl group or groups, X is ethylene oxide, and Y is ethylene oxide.

11. (Original) The method of claim 10 wherein X is from about 2 to about 15 moles of the ethylene oxide.

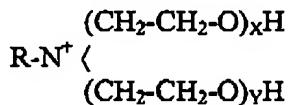
12. (Original) The method of claim 10 wherein Y is from about 2 to about 15 moles of the ethylene oxide.

13. (Original) The method of claim 10 wherein X is from about 10 to about 15 moles of the ethylene oxide.

14. (Original) The method of claim 10 wherein Y is from about 10 to about 15 moles of the ethylene oxide.

15. (Original) The method of claim 10 wherein the first pH is at least about 11 with a half-life of the fracturing fluid at the first pH of greater than about 15.

16. (Original) The method of claim 9 wherein the surfactant is a tertiary alkyl amine ethoxylate generally represented by the following formula when the pH of the fracturing fluid is the second pH:



wherein R is an alkyl group or groups, X is ethylene oxide, and Y is ethylene oxide.

*Atty Docket: 2003-JP-011752U1  
(1391-39401)*

*Patent*

17. (Original) The method of claim 16 wherein X is from about 2 to about 15 moles of the ethylene oxide.
18. (Original) The method of claim 16 wherein Y is from about 2 to about 15 moles of the ethylene oxide.
19. (Original) The method of claim 16 wherein X is from about 10 to about 15 moles of the ethylene oxide.
20. (Original) The method of claim 16 wherein Y is from about 10 to about 15 moles of the ethylene oxide.
21. (Original) The method of claim 16 wherein the second pH is less than about 9 with a half-life of the fracturing fluid at the second pH of less than about 2.
22. (Original) The method of claim 9 wherein the surfactant comprises an amphoteric compound and an anionic compound.
23. (Original) The method of claim 122 wherein the amphoteric compound comprises laurylamine oxide, myristylamine oxide, cocoamine oxide, lauryl betaine, cocoamido propyl betaine, oleyl betaine, or combinations thereof.
24. (Original) The method of claim 22 wherein the anionic surfactant comprises C<sub>4-12</sub> alcoholether sulfate,  $\alpha$ -olefin sulfonate, sulfonated C<sub>15</sub> alcohol, sodium lauryl-2-sulfate, sodium lauryl-3-sulfate, or combinations thereof.
25. (Original) The method of claim 24 wherein the sulfonated C<sub>15</sub> alcohol is substituted with from about 12 to about 40 moles of ethylene oxide.
26. (Original) The method of claim 22 wherein the first pH is at least about 11.
27. (Original) The method of claim 17 wherein the second pH is less than about 9.

*Atty Docket: 2003-IP-011752UI  
(1391-39401)*

*Patent*

28. (Original) The method of claim 1 wherein the fracturing fluid comprises a gelling agent.
29. (Original) The method of claim 28 wherein the gelling agent comprises depolymerized hydroxypropyl guar, hydroxypropyl guar, guar gum, locust bean gum, hydroxyethyl guar, hydroxyethyl carboxymethyl guar, hydroxypropyl carboxymethyl guar, carboxymethyl guar, hydroxyethyl cellulose, hydroxyethyl carboxymethyl cellulose, carboxymethyl cellulose, methyl cellulose, xanthan gum, welan gum, or combinations thereof.
30. (Original) The method of claim 28 wherein the gelling agent comprises depolymerized hydroxypropyl guar.
31. (Original) The method of claim 1 wherein the subterranean formation comprises a coal bed.
32. (Original) The method of claim 31 wherein the coal bed comprises methane.
33. (Original) The method of claim 1, further comprising the steps of recovering the fracturing fluid, re-foaming the fracturing fluid, and injecting the foamed fracturing fluid downhole.
34. (Original) A method of fracturing a subterranean formation, comprising the steps of:
  - (a) providing a fracturing fluid having a first pH;
  - (b) foaming the fracturing fluid; and
  - (c) introducing the foamed fracturing fluid into a subterranean formation to fracture the subterranean formation; and
  - (d) defoaming the fracturing fluid by changing the pH of the fracturing fluid to a second pH, wherein the first pH and the second pH are each basic, the second pH being less basic than the first pH.

*Atty Docket: 2003-IP-011752U1  
(1391-39401)*

*Patent*

35. (Original) A method of making a fracturing fluid, comprising: combining a gelling agent and a surfactant to form a mixture having a first pH, wherein the surfactant is capable of facilitating foaming of the fracturing fluid at the first pH and defoaming of the fracturing fluid when its pH is changed to a second pH.

36. (Original) A fracturing fluid made by the method of claim 35.